

CLAIMS

What is claimed is:

1. A method for forming device packages, comprising:
 - forming a perimeter comprising a reactive foil and a bonding material interposed between a first wafer and a second wafer;
 - pressing the first and the second wafers against the reactive foil and the bonding material;
 - initiating the reactive foil, the reactive foil heating the bonding material to create a bond between the first and the second wafers; and
 - singulating the first and the second wafers into device packages.
2. The method of claim 1, wherein said forming a perimeter comprises:
 - forming a first photoresist layer atop the first wafer, the first photoresist layer having a first development rate;
 - forming a second photoresist layer atop the first photoresist layer, the second photoresist layer having a second development rate, the second development rate being slower than the first development rate;
 - exposing the first and the second photoresist layers to a pattern;
 - removing exposed regions of the first and the second photoresist layers to form a window to the first wafer, the window including an undercut profile;
 - depositing the reactive foil atop unexposed regions of the first and second photoresist layers and through the window onto the first wafer; and
 - stripping the unexposed regions of first and the second photoresist layers to lift off the reactive foil thereon.
3. The method of claim 2, wherein said forming a perimeter further comprises:
 - depositing the bonding material on the reactive foil through the window, wherein said stripping also lifts off the bonding material on the first and the second photoresist layers.
4. The method of claim 2, wherein said forming a perimeter further comprises:
 - patterning a mask on the first wafer;

depositing the bonding material over the first wafer, wherein said depositing is a step selected from the group consisting of plating and screen printing; and stripping the mask to lift off the bonding material thereon.

5. The method of claim 1, wherein said forming a perimeter comprises:

forming a first photoresist layer atop the first wafer;
defining a first region of the first photoresist layer to be removed;
forming a second photoresist layer atop the first photoresist layer;
defining a second region of the second photoresist layer to be removed, the second region being above the first region, the second region being smaller than the first region;
removing the first and the second regions to form a window to the first wafer, the window including an undercut profile;
depositing the reactive foil through the window onto the first wafer; and
stripping remaining regions of first and the second photoresist layers to lift off the reactive foil thereon.

6. The method of claim 5, wherein said forming a perimeter further comprises:

depositing the bonding material on the reactive foil through the window, wherein said stripping also lifts off the bonding material on the first and the second photoresist layers.

7. The method of claim 5, wherein said forming a perimeter further comprises:

patterning a mask on the first wafer;
depositing the bonding material over the first wafer, wherein said depositing is a step selected from the group consisting of plating and screen printing; and
stripping the mask to lift off the bonding material thereon.

8. The method of claim 1, wherein said forming a perimeter comprises:

placing a mechanical mask over the first wafer, the mechanical mask comprising a window, the window including an undercut profile;
depositing the reactive foil through the window onto the first wafer.

9. The method of claim 8, wherein said forming a perimeter further comprises:
- depositing the bonding material on the reactive foil through the window,
 - wherein said stripping also lifts off the bonding material on the first and the second photoresist layers.
10. The method of claim 8, wherein said forming a perimeter further comprises:
- patterning a mask on the first wafer;
 - depositing the bonding material over the first wafer, wherein said depositing is a step selected from the group consisting of plating and screen printing; and
 - stripping the mask to lift off the bonding material thereon.
11. The method of claim 1, wherein said forming a perimeter comprises:
- depositing the reactive foil onto the first wafer;
 - forming a photoresist layer atop the reactive foil;
 - patterning the photoresist layer to define a window; and
 - removing a region of the reactive foil exposed through the window.
12. The method of claim 1, wherein the second wafer defines a hole, the method further comprising:
- forming a second reactive foil and a second bonding material interposed between a device and the first wafer;
 - placing the device through the hole in the second wafer and onto the first wafer;
 - pressing the device and the first wafer against the second reactive foil and the second bonding material; and
 - initiating the second reactive foil, the second reactive foil heating the second bonding material to create a second bond between the device and the first wafer.
13. The method of claim 1, wherein the first wafer includes a device at a first location and the second wafer defines a cavity at a second location opposite of the first location.
14. The method of claim 13, further comprising:

forming a second reactive foil and a second bonding material interposed between the device and the first wafer;

pressing the device and the first wafer against the second reactive foil and the second bonding material; and

initiating the second reactive foil, the second reactive foil heating the second bonding material to create a second bond between the device and the first wafer.

15. The method of claim 1, further comprising:

forming a second perimeter comprising a second reactive foil and a second bonding material interposed between the second wafer and a third wafer;

pressing the second and the third wafers against the second reactive foil and the second bonding material; and

initiating the second reactive foil, the second reactive foil heating the second bonding material to create a second bond between the second and the third wafers.

16. The method of claim 15, wherein the first wafer includes a device located at a first location and the second wafer defines a hole located at a second location opposite of the first location.

17. The method of claim 16, further comprising:

forming a third reactive foil and a third bonding material interposed between the device and the first wafer;

compressing the device and the first wafer against the third reactive foil and the third bonding material; and

initiating the third reactive foil, the third reactive foil heating the third bonding material to create a third bond between the device and the first wafer.

18. The method of claim 1, wherein said forming a perimeter comprises:

forming the bonding material atop the first wafer; and

forming the reactive foil atop of the bonding material.

19. The method of claim 18, wherein the perimeter further comprises a second bonding material, said forming a perimeter further comprising forming the second bonding material atop of the reactive foil.
20. A device package, comprising:
- a first wafer;
 - a second wafer; and
 - a perimeter of an intermetallic mixture interposed between the first and the second wafers, the intermetallic mixture comprising materials from a reactive foil and a bonding material, the intermetallic mixture being formed after an exothermic reaction of the reactive foil.
21. The device package of claim 20, further comprising:
- a device; and
 - a second intermetallic mixture interposed between the device and the first wafer, the second intermetallic mixture comprising materials from a second reactive foil and a second bonding material, the second intermetallic mixture being formed after a second exothermic reaction of the second reactive foil.
22. The device package of claim 20, wherein the second wafer comprises a feature selected from the group consisting of a hole and a cavity.
23. The device package of claim 20, further comprising:
- a third wafer; and
 - a second perimeter of a second intermetallic mixture interposed between the second and the third wafers, the second intermetallic mixture comprising materials from a second reactive foil and a second bonding material, the intermetallic mixture being formed after a second exothermic reaction of the second reactive foil.
24. A method for bonding devices to wafers, comprising:
- patterning a metal layer on a wafer to form metal lines;
 - patterning a reactive foil and a bonding material interposed between a device and the metal lines on the wafer;

pressing the device and the wafer against the reactive foil and the bonding material; and

initiating the reactive foil, the reactive foil heating the bonding material to create a bond between the device and the metal layer on the wafer.

25. The method of claim 24, wherein the device is selected from the group consisting a MEMS (micro-electromechanical systems) device, an electronic device, and an optoelectronic device.

26. A device wafer package, comprising:

a wafer having metal lines;

a device; and

an intermetallic mixture interposed between the device and the metal lines, the intermetallic mixture comprising materials from a reactive foil and a bonding material, the intermetallic mixture being formed after an exothermic reaction of the reactive foil.

27. The package of claim 26, wherein the device is selected from the group consisting a MEMS (micro-electromechanical systems) device, an electronic device, and an optoelectronic device.